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Original Article

Site-Specific Epidemiology of Limb Fractures in Older Adults in Northwest Iran: A Four-Year Retrospective Study

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Abstract

Objectives: This study aimed to describe the site-specific distribution of limb fractures among adults aged 65 years and older who were admitted to a tertiary orthopedic center in Northwest Iran. It also sought to assess sex differences and year-to-year variation in fracture patterns between 2021 and 2024 (1400–1403 Hijri Shamsi).

Design: This investigation was conducted as a retrospective, hospital-based study using digitized fracture-registry data.

Setting(s): The study was carried out at Shohada Hospital, a tertiary orthopedic referral center in Tabriz, Northwest Iran.

Participants: The study population consisted of all inpatients aged ≥ 65 years presented with radiographically confirmed limb fractures between 1400–1403 Hijri Shamsi (2021–2024). Pathological fractures were excluded from analysis. High-energy trauma cases were not systematically excluded due to incomplete mechanism-of-injury data.

Outcome Measures: We retrospectively analyzed radiographically confirmed limb fractures using variables that included anatomical fracture site, sex, and year of admission. Pathological fractures were excluded, and high-energy trauma was not systematically removed due to incomplete documentation. Descriptive statistics were computed, and chi-square tests were performed to compare sex distributions across fracture sites and to assess associations between calendar year and hip-fracture counts relative to annual totals. All analyses were conducted using IBM SPSS Statistics version 26 and Microsoft Excel 2019.

Results: Hip fractures, including intertrochanteric and femoral-neck types, and distal radius fractures accounted for the largest shares of fracture-related admissions. Sex distributions differed significantly across sites ($\chi^2 = 340.9$, df = 28, $P < 0.001$). Hip-fracture proportions varied across study years, although these fluctuations were not statistically significant (intertrochanteric $\chi^2 = 4.0$, df = 3, $P = 0.261$; femoral-neck $\chi^2 = 0.6$, df = 3, $P = 0.888$). Sex fields were missing for several rare sites.

Conclusions: Hip fractures (intertrochanteric and femoral-neck types) and distal radius fractures represented the largest proportions of admissions among older adults in this tertiary referral center. Pronounced sex differences were observed across fracture sites. Because these findings are derived from a single tertiary hospital without population denominators, incidence comparisons should be interpreted cautiously. These results may inform local fall-prevention strategies and osteoporosis-screening initiatives.

Keywords: Fragility fractures, Hip fracture, Distal radius fracture, Older adults, Epidemiology, Iran, Retrospective study

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Introduction

Hip fractures impose the greatest clinical and societal burden among fragility fractures in older adults.[1,2] Although global patterns of fracture epidemiology have been extensively documented 3, site-specific data from Iran remain comparatively limited. A national meta-analysis has reported substantial hip-fracture incidence in Iran,[4] and large-scale reviews consistently document high osteoporosis prevalence and widespread vitamin D deficiency among Iranian adults.[5,6] Against this background, we analyzed a four-year, hospital-based fracture registry to (i) characterize the distribution of limb-fracture sites, (ii) quantify sex differences, and (iii) explore year-to-year variation in fracture patterns, while

acknowledging the inherent case-mix constraints of a tertiary referral center.[7-19]

Methods

Design and Setting

This retrospective, single-center study was conducted at Shohada Hospital in Tabriz, a tertiary orthopedic referral center. The study period spanned 1400–1403 Hijri Shamsi (2021–2024 Gregorian).

Data Source and Processing

Departmental fracture-registry records were digitized using a standardized form capturing year of admission, sex, and anatomical site. Two orthopedic surgeons harmonized site definitions, and any discrepancies were resolved by consensus. Missing data fields were retained without imputation.

Eligibility Criteria

Eligible cases included all adults aged ≥ 65 years with radiographically confirmed limb fractures admitted for inpatient orthopedic care. Pathological fractures caused by malignancy were excluded. High-energy trauma was not systematically excluded because mechanism-of-injury fields were inconsistently captured; this is addressed as a limitation.

Variables and Outcomes

Variables included anatomical fracture site, sex, and year of admission. Primary outcomes included yearly counts and within-year proportions by anatomical site, as well as sex distributions aggregated across the study window.

Statistical Analysis and Software

Descriptive statistics summarized counts and percentages. Chi-square tests were performed to compare sex distributions across fracture sites ($2 \times K$ contingency: $\chi^2 = 340.9$, df = 28, $P = < 0.001$) and to assess associations between study year and hip-fracture frequencies relative to annual totals (intertrochanteric: $\chi^2 = 4.0$, df = 3, $P = 0.261$; femoral neck: $\chi^2 = 0.6$, df = 3, $P = 0.888$). A two-sided $P < 0.05$ denoted statistical significance. All analyses used IBM SPSS Statistics version 26 and Microsoft Excel 2019.

Ethics

This study received formal approval from the Ethics Committee of the affiliated university (the approval number was obtained but is not reported here to maintain institutional anonymity). Due to the retrospective nature of the study, the committee granted a waiver of individual informed consent in accordance with institutional guidelines for retrospective chart reviews, during which all patient identifiers are removed before analysis. All procedures for data collection and management complied with the Declaration of Helsinki and institutional privacy regulations. The hospital administration provided formal permission to access medical records, and a data-sharing agreement was established between departments to ensure appropriate data governance throughout the research process.

Results

During the 1400–1403 Hijri Shamsi period (2021–2024 Gregorian), intertrochanteric and femoral-neck hip fractures and distal radius fractures were the most frequently recorded sites. Sex distributions differed significantly across fracture sites ($\chi^2 = 340.9$, df = 28, $P < 0.001$). Study year was not significantly associated with the proportion of hip fractures relative to annual totals (intertrochanteric: $P = 0.261$; femoral neck: $P = 0.888$). Sex fields were not recorded for metacarpal, great toe, and small-toe fractures.

The eight most common fracture sites during the study period are presented in Figure 1. Annual hip-fracture patterns are illustrated in Figure 2. Yearly counts of distal radius fractures and combined distal radius–ulna fractures are illustrated in Figure 3.

Detailed yearly fracture counts are reported in Table 1. The within-year proportional distribution of each fracture site is summarized in Table 2. Sex-specific counts for all fracture sites are presented in Table 3.

Discussion

Over the four calendar years examined, this hospital-based series demonstrates that hip fractures, specifically intertrochanteric and femoral-neck fractures) and distal radius fractures constituted the largest proportion of elderly fracture admissions, in keeping with international patterns and burden estimates.[1–3] A national meta-analysis has reported a substantial incidence of hip fractures in Iran,[4] and the high prevalence of osteoporosis and vitamin D deficiency among Iranian adults provides important context for fragility risk.[5,6] The pronounced sex differences observed in our dataset align with established epidemiological patterns, and the modest year-to-year variation is consistent with relatively stable age-adjusted hip-fracture rates reported in parts of Asia.[15]

We refrain from direct incidence comparisons because our dataset lacks population denominators and reflects a tertiary-care referral case mix. Referral patterns may have influenced the relative burden of hip fractures, as less severe wrist and ankle fractures can be managed in peripheral hospitals; nonetheless, the ankle-fracture distribution is broadly consistent with population-based reports [11,12]. International and regional evidence supports orthogeriatric co-management and structured secondary-prevention programs as strategies to improve outcomes and reduce healthcare costs.[13,14,19] Global and Eastern Mediterranean Region reviews further contextualize the underlying skeletal risk.[16,17] Within Iran, population-based studies highlight fall-related determinants among older adults, and pandemic-era disruptions affected hip-fracture care pathways.[8,9,10,18]

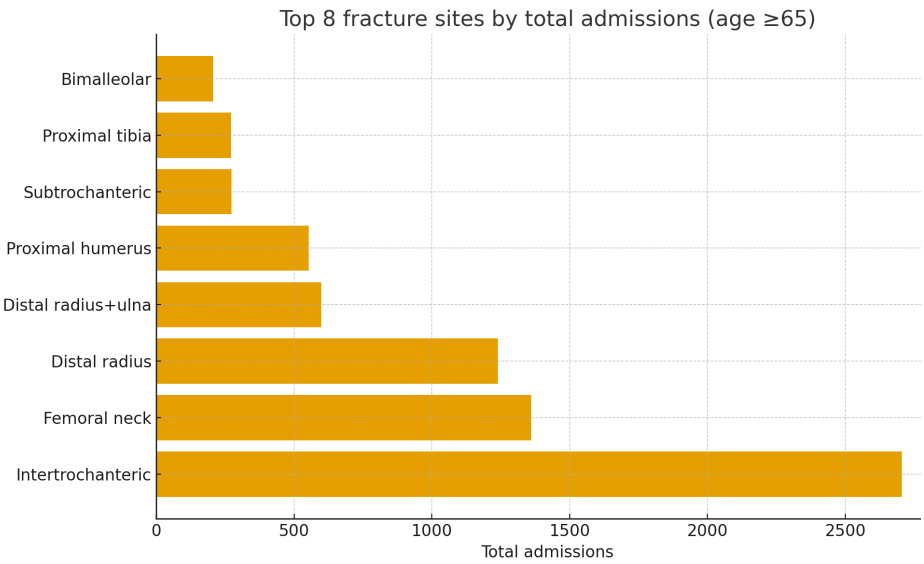

Figure 1. Top Eight Fracture Sites by Total Admissions (2021–2024)

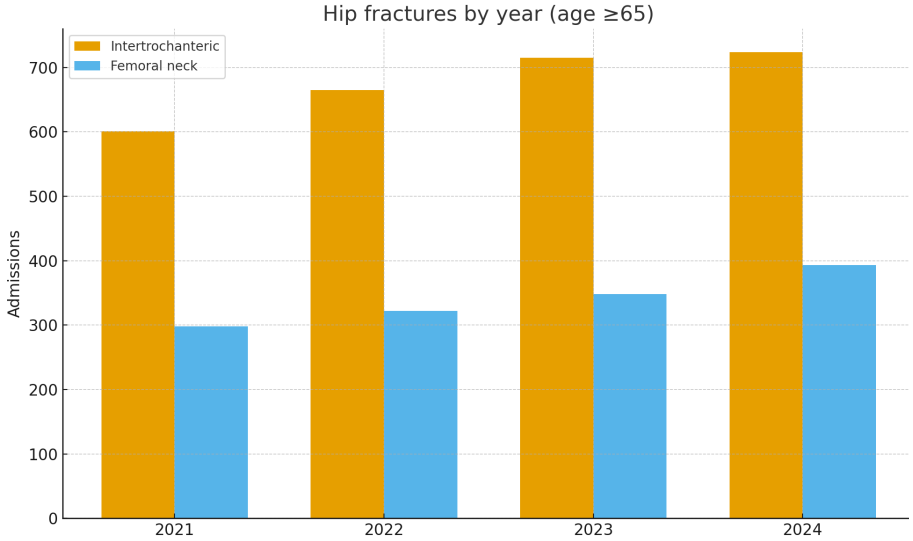

Figure 2. Annual Distribution of Hip Fractures (Intertrochanteric and Femoral Neck), 2021–2024

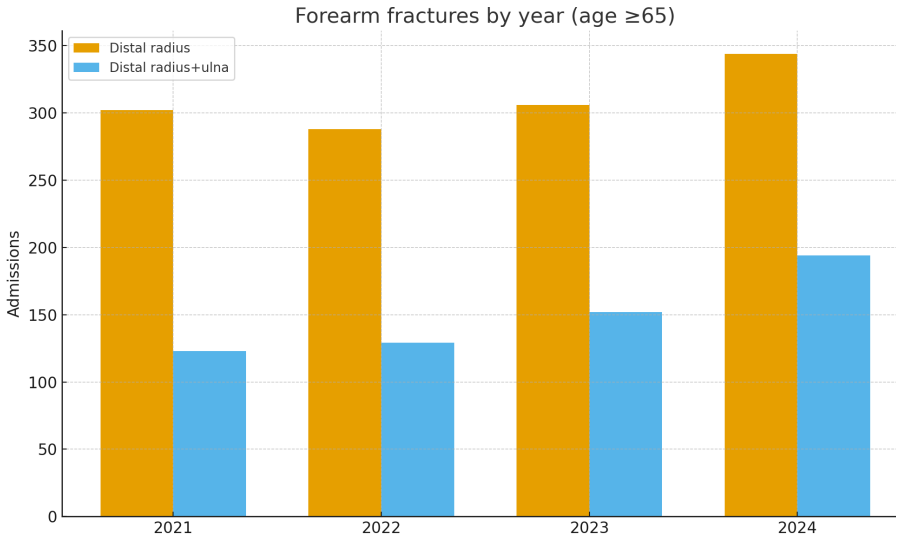

Figure 3. Annual distribution of Forearm Fractures (Distal Radius and Distal Radius+Ulna), 2021–2024

Table 1. Fracture Counts by Site and Year (age ≥ 65), (2021–2024)

Fracture site	2021	2022	2023	2024	Total
Clavicle	20	20	31	22	93
Scapula	2	12	20	8	42
Proximal Humerus	128	139	129	157	553
Humeral Shaft	24	36	45	36	141
Radial Head	17	21	19	30	87
Proximal Ulna	22	29	21	30	102
Radial Shaft	8	15	13	4	40
Ulnar Shaft	12	12	13	12	49
Both-bone Forearm	4	6	6	25	41
Multiple Forearm	11	4	10	7	32
Distal Radius	302	288	306	344	1240
Distal Radius + Ulna	123	129	152	194	598
Scaphoid	9	7	8	7	31
Metacarpal	12	23	31	41	107
Thumb	13	11	14	9	47
Femoral Neck	298	322	348	393	1361
Intertrochanteric	601	665	715	724	2705
Subtrochanteric	61	52	74	85	272
Multiple Femur	47	43	40	52	182
Distal Femur	36	37	33	61	167
Patella	28	26	23	35	112
Proximal Tibia	46	75	70	80	271
Tibial Shaft	35	42	41	64	182
Fibula	15	41	44	34	134
Distal Tibia	45	52	52	44	193
Medial Malleolus	50	25	21	26	122
Lateral Malleolus	58	30	40	48	176
Bimalleolar	8	65	61	72	206
Talus	1	8	13	6	28
Calcaneus	0	22	37	36	95
Metatarsal	17	50	50	14	131
Great Toe	10	15	16	12	53
Foot Fingers	12	2	11	2	27

Table 2. Within-year Share of Each Fracture Site (% of that year's total), (2021–2024)

Fracture Site	2021	2022	2023	2024
Clavicle	1.0	0.9	1.2	0.8
Scapula	0.1	0.5	0.8	0.3
Proximal Humerus	6.2	6.0	5.1	5.8
Humeral Shaft	1.2	1.5	1.8	1.3
Radial Head	0.8	0.9	0.8	1.1
Proximal Ulna	1.1	1.2	0.8	1.1
Radial Shaft	0.4	0.6	0.5	0.1
Ulnar Shaft	0.6	0.5	0.5	0.4
Both-bone Forearm	0.2	0.3	0.2	0.9
Multiple Forearm	0.5	0.2	0.4	0.3
Distal Radius	14.6	12.4	12.2	12.7
Distal Radius + ulna	5.9	5.6	6.1	7.1
Scaphoid	0.4	0.3	0.3	0.3
Metacarpal	0.6	1.0	1.2	1.5
Thumb	0.6	0.5	0.6	0.3
Femoral Neck	14.4	13.9	13.9	14.5
Intertrochanteric	29.0	28.6	28.5	26.7
Subtrochanteric	2.9	2.2	3.0	3.1
Multiple Femur	2.3	1.9	1.6	1.9
Distal Femur	1.7	1.6	1.3	2.2
Patella	1.3	1.1	0.9	1.3
Proximal Tibia	2.2	3.2	2.8	2.9
Tibial Shaft	1.7	1.8	1.6	2.4
Fibula	0.7	1.8	1.8	1.3
Distal Tibia	2.2	2.2	2.1	1.6
Medial Malleolus	2.4	1.1	0.8	1.0
Lateral Malleolus	2.8	1.3	1.6	1.8
Bimalleolar	0.4	2.8	2.4	2.7
Talus	0.0	0.3	0.5	0.2
Calcaneus	0.0	0.9	1.5	1.3
Metatarsal	0.8	2.2	2.0	0.5
Great Toe	0.5	0.6	0.6	0.4
Foot Fingers	0.6	0.1	0.4	0.1

Limitations

This single-center, referral-based study may have introduced referral bias, potentially over-representing more severe fractures such as hip fractures. Mechanism-of-injury fields were incompletely captured; therefore, high-energy trauma could not be systematically excluded. Population denominators were unavailable, preventing incidence estimation. Additionally, age stratification and outcomes (e.g., mortality, function) were not recorded. Sex fields were missing for several rare sites (metacarpal, great toe, small toes).

Conclusions

This four-year, hospital-based study characterizes the distribution of fractures among older adults in Northwest Iran between 1400–1403 Hijri Shamsi (2021–2024 Gregorian). Hip fractures (intertrochanteric and femoral-neck) and distal radius fractures appeared to represent the largest proportions of admissions, with women more frequently sustaining hip and forearm fractures and men more often presenting with humeral- and tibial-shaft fractures as well as ankle injuries. Because these findings are derived from a single tertiary referral hospital, direct comparison with population-level incidence should be interpreted cautiously, as referral patterns may have influenced the observed distribution of fracture types. Further population-based surveillance and targeted prevention strategies are needed to clarify fracture trends and reduce the burden of fragility fractures in this region.

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Table 3. Sex Distribution by Fracture Site (2021–2024)

Fracture Site	Female (n)	Male (n)	Total (n)
Clavicle	29	64	93
Scapula	13	29	42
Proximal Humerus	371	182	553
Humeral Shaft	81	60	141
Radial Head	56	31	87
Proximal Ulna	52	50	102
Radial Shaft	22	18	40
Ulnar Shaft	20	29	49
Both-bone Forearm	21	20	41
Multiple Forearm	20	12	32
Distal Radius	818	422	1240
Distal Radius + ulna	446	152	598
Scaphoid	15	16	31
Metacarpal	Not recorded	Not recorded	107
Thumb	18	29	47
Femoral Neck	720	641	1361
Intertrochanteric	1439	1266	2705
Subtrochanteric	172	100	272
Multiple Femur	133	49	182
Distal Femur	135	32	167
Patella	62	50	112
Proximal Tibia	136	135	271
Tibial Shaft	77	105	182
Fibula	53	81	134
Distal Tibia	99	94	193
Medial Malleolus	69	53	122
Lateral Malleolus	87	89	176
Bimalleolar	120	86	206
Talus	10	18	28
Calcaneus	39	56	95
Metatarsal	Not recorded	Not recorded	131
Great Toe	Not recorded	Not recorded	53
Foot Fingers	Not recorded	Not recorded	27

Note. Sex fields were missing for metacarpal, great-toe, and small-toe fractures; totals for these sites are reported, but sex-specific counts were not recorded in the registry.

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Author contributions

Conceptualization: Asghar Elmi.
Data curation: Asghar Elmi.
Formal analysis: Arsalan Ranjbar.
Investigation: Asghar Elmi, Arsalan Ranjbar.
Methodology: Arsalan Ranjbar.
Project administration: Arsalan Ranjbar.
Resources: Asghar Elmi.
Software: Arsalan Ranjbar.
Supervision: Asghar Elmi.
Validation: Asghar Elmi.
Visualization: Arsalan Ranjbar.
Writing–original draft: Arsalan Ranjbar.
Writing–review & editing: Arsalan Ranjbar.

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Data availability statement

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval

This study was conducted using previously recorded hospital data and involved no direct human or animal intervention. All data were analyzed in a fully anonymized form. Permission to access and use the hospital records was obtained from the hospital administration, and the study did not require formal ethics committee approval according to institutional regulations.

Consent for publication

The hospital administration provided formal permission for access to medical records, and a data-sharing agreement was established between departments to ensure appropriate data governance throughout the research process.

Conflict of interests

The authors declare no competing interests.

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